DOCUMENT RESUME

ED 034 676 SE 006 771

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TITLE	SPRUCE Discovery Manual, 169 Investigations Indoors and Outdoors.
INSTITUTION	Ulster County Board of Cooperative Education Services, New Platz, N.Y.
SPONS AGENCY	Office of Education (DHEW), Washington, D.C. Bureau of Elementary and Secondary Education.
PUB DATE	[69]
NOTE	60p.
EDRS PRICE	EDRS Price MF-$0.50 HC-$3.10
DESCRIPTORS	*Biology, *Conservation Education, Ecology, *Elementary School Science, *Instructional Materials, *Outdoor Education, Science Activities, Teaching Guides
IDENTIFIERS	ESEA Title III

ABSTRACT

Contained are instructional materials developed by the Science Project Related to Upgrading Conservation Education ("SPRUCE"). It is designed for use with the SPRUCE "Discovery Box" and contains twenty-one sets of investigations based on the twenty-one packets of specimens in the box; three sets are recommended for each of Grades K through 6. Each of the twenty-one topics is introduced by a "background" section giving the rationale of the investigations and background information for the teacher. This is followed by four to ten "investigations"--questions and suggested activities which require students to observe and compare, sometimes to do simple experiments, and usually to extend their observations outside the classroom. The early topics emphasize the use of the senses in observing, later ones enable students to make discoveries about the characteristics of organisms and habitats. Themes which run through the investigations are constant change in nature and the interaction between organisms and their environments. The introduction to the manual describes the approach of the materials and makes a plea for improved conservation education. Ways in which this can be fitted into the general curriculum are suggested. The contents of the "Discovery Box" are not listed, but can be inferred from the background sections and investigations. This work was prepared under an ESEA Title III contract. (EB)

OE-BESE
TITLE-III

ED034676

SPRUCE

DISCOVERY

MANUAL

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169 INVESTIGATIONS

INDOORS AND OUTDOORS

By Dr. Phyllis S. Busch
Director, Project SPRUCE

Science Project Related to Upgrading Conservation Education

SE 006 771

SPRUCE DISCOVERY MANUAL

169 Investigations Indoors and Outdoors

By, Dr. Phyllis S. Busch

Techniques for Exploring the

TOTAL ENVIRONMENT

Distributed by: Project SPRUCE
Pine Plains, New York 12567

Operated by: Ulster County BOCES
Henry Hopper, Superintendent

The work presented or reported herein was performed pursuant to a Grant from the U.S. Office of Education, Department of Health, Education, and Welfare. However, the opinions expressed herein do not necessarily reflect the position or policy of the U.S. Office of Education, and no official endorsement by the U.S. Office of Education should be inferred.

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INTRODUCTION

Purpose of the Discovery Box

There are several points of agreement among the members of the science-teaching community today. It is accepted that "telling the facts of science" is a waste of time. Telling is not teaching and facts are easily forgotten. Moreover, "solid facts" change.

However, there are so-called "big ideas" or "conceptual schemes" which do not change. One example is that living things in a community interact with each other and with their environment. Another "big idea" is that everything is constantly changing; nothing remains static.

Another point of agreement is that learning by inquiry -- by exploring -- by investigating is a most fruitful way to pursue one's education. Such learning involves the child in problem-solving. Great emphasis is placed on the processes of science. One might say that children who are exposed to such techniques learn how to learn.

Everyone may not agree on the extent of the sorry condition of our planet but all will accept that there is great need for improvement. Science has been used for developing a technology which is decreasing the earth's resources while it is increasing air and water pollution, crowds, junk, noise, ugliness. Man suffers from all of this. Little has been done to combat or prevent these conditions either through ignorance of the consequences or through indifference.

Man is a part of the world of living things and reacts to environmental changes as do other living things. This calls for an ecological emphasis in our teaching. Such emphasis will logically lead to conservation. Conservation is something active. One has to do something. When man realizes that only he can willingly alter his environment and that only he can predict the outcomes of these alterations perhaps he will be prepared to assume a sense of responsibility which he will translate into action. It is agreed that this might be achieved by inculcating appropriate attitudes and values. How? By education. Who? Everyone -- beginning with Kindergarten.

Project SPRUCE recognizes and adheres to these points of agreement. Where there are uncertainties, decisions had to be made. Conservation should not be taught as a separate course. Science is a logical vehicle for including an opportunity for children to develop conservation concepts. Social studies is another such avenue. Both should lead to action.

In order to emphasize man's relation to and interaction with his environment, the teacher must incorporate experience in the <u>total environment</u>, outdoors as well as indoors.

The SPRUCE Discovery Box is but one small way that has been designed to introduce children to their world -- indoors and out. They are stimulated and made aware of significant parts of their environment by small samples from it. They are led to inquire and to investigate. The results will be most profitable where the children recognize interrelationship and where they realize man's manipulations with environment. Best of all will be those lessons which result in constructive action.

How to Use the Discovery Box

The 21 items which consist of samples collected from the environment outdoors, are all packaged and clearly labeled. Although each item has been recommended for a particular grade, any grade from K to 6 can benefit from each kind of material. Some items are for demonstration. Many are provided in sufficient quantity for individual experimentation.

It is suggested that the SPRUCE Discovery Box collection be put on display in the library or other appropriate room where all the children can view them. After several days the individual items should be sent to the grades as indicated in the table of contents of the teachers' manual, 169 Investigations.

For each specimen the manual has a section called, "Background." This provides the teacher with needed information for helping the pupils carry out their investigations.

This background section is followed by several suggested problems to be investigated. These are designed to motivate the children to learn something about this sample of their world. They are guided to hypothesize, observe, collect data, make inferences, develop new problems, design experiments, classify, and generally gain practice in the processes of science. The teacher should encourage the introduction of as many original investigations as possible.

The complete manual can be place with the school faculty's professional library. The sectional manual contains the necessary background and investigations for the 21 items, and accordingly consists of 21 sections. Each section, together with its sample should be given to the teacher who will use it in class.

TOUCHING

Background:

A number of investigations are provided whereby children can find out that one way to learn about certain things in the world is to use their sense of touch. Contrasts are offered through experiences with sandpaper, a twig and rabbit fur. The fur has been processed. Some coarse sandpaper and a bottle of sand is provided. Sandpaper is made in different grades, according to the size of the sand grains used. There is enough sandpaper to accommodate each child with a piece. The sand in the bag is for making sandpaper.

The twig has been cut from the staghorn sumac, a non-poisonous shrub. It is distinguished from the more common smooth sumac by the hairs on the outside of the twigs.

Investigations:

1. Which feels softer, your hair, your skin, the rabbit fur, or the twig? Close your eyes and touch each with your fingertips.

2. After you have decided which is the softest find out whether it feels softer to the back of your hand, the front, or the fingertips. What is the best part of your hand to use for finding out how things feel by touching them?

3. Is it the length of the hair or fur which makes things feel softer? First compare the length of your hair, rabbit hair, twig hair. Which is longest? Which is softest? A magnifier could be used on the twig and on the rabbit skin.

4. Which of the hairs are closer together? Again, the magnifier will help to discover this.

5. How is the hair on your arms like rabbit fur? like the hairs on the twig? If you think of something scratching on the board it might make your arm hairs straighten up and they will be easier to examine.

6. Which of the animals around the schools have warm coats? Why should you not touch them?

7. Do you know of any winter hiding places of animals which do not have warm coats? Think of where you might look, then explore those places. Examples of where to look might be under stones, under loose bark of a tree, under a fallen log, against a building and covered with fluffy white material.

8. You do not have a furry skin. How do you keep warm in winter? Take a walk on a winter day and discover the different ways in which people keep warm.

9. How does each side of the sandpaper feel when you touch it with your fingertips?

10. How does each side feel when you touch it gently to your cheek? Which is more sensitive, your cheek or the tips of your fingers?

11. How is sandpaper made? Examine each side with a magnifier. Can you find the grains of sand on one side?

12. Where around your school is sand? Collect some, put it into a salt shaker and sprinkle it over a piece of paper covered with wet glue. After it dries you have sandpaper. You can use different kinds of sand. Can you tell one from another by touch?

13. How is sandpaper used? See whether cutting a piece of sandpaper will sharpen your scissors. Will sandpaper remove rust from metal objects like skates and door hinges?

14. Which moves more easily over the desk the smooth side of the sandpaper or the rough side? When is sand sprinkled on the roads? On a winter day after the road has been sanded look at the cars. What do cars have to prevent skidding?

15. How can you help to keep people from slipping on icy walks? Perhaps you can take charge of sanding one spot each time it is slippery.

SMELLING

Background:

Much can be learned through one's sense of smell. There are many opportunities to concentrate on this sense in the world of plants. Wild thyme which has been dried, fall pennyroyal and cloves are offered for investigation.

Wild thyme was obtained in a pasture along the road where it flourishes in purple profusion in late summer, then dried by being hung in an attic.

Pennyroyal is a common weed found in waste places. It has inconspicuous bluish blooms in late summer, then turns a lovely brown in the fall. It has a repellent effect on insects, and has been consequently used in "fly dope."

The clove trees of India, Madagascar and Zanzibar provide us with cloves, the tree buds which must be pricked before they bloom. About 40,000 buds can be collected from one tree.

Herbs and spices have always been important in preserving, scenting, seasoning.

There is enough thyme and cloves for class distribution. Pennyroyal was not obtainable in large quantities.

Investigations:

1. Do you recognize the smell of cloves? Sniff one. In what room of the house do you smell it? For what is it used?

2. Does heat make things smell stronger? Hold your clove rolled tightly in your fist while your classmate leaves his on the table. Sniff each one to find whether the warm clove smells

stronger or weaker than the other clove.

3. Does a clove smell stronger when it is whole or when it is ground? Work in pairs. One leaves his clove alone. The other wraps his in newspaper, then crushes it with his foot. Now smell both. Which smells more strongly?

4. A clove is a bud of a tree. Are there fragrant tree buds around your school? You can take a walk around your school, collect a few buds for which your teacher has given you permission. Crush one at a time. Are any fragrant?

5. Do cloves preserve oranges? Obtain a small orange. Smell it. Do the same with a lemon. Can you tell the difference between an orange and a lemon by smelling them with eyes shut? Test your friends. Stick as many cloves as you can in the orange or lemon. You can then roll it in orris root which can be bought at the drugstore. You now have a pomander ball. Place this in a dish on a table. In another dish place the same kind of fruit which has not been made into a pomander ball. Sniff each from time to time. Which is more fragrant? What changes take place in each fruit?

6. Do all people prefer the same smells? Which herb smells pleasanter to you, pennyroyal or thyme? How many of your classmates agree?

7. Do you have any fragrant herbs growing around the school? What fragrant flowers grow wild? Which are planted?

8. Sniff the air in your classroom. How does it compare with fresh air outdoors?

9. Does air smell differently after a rain from how it smelled

during a rain? Prepare for this investigation the next time it rains.

10. How does the air smell where there is much traffic? How does it smell where there is little traffic? How does the air smell near a gas station? Near which of these places would you rather live?

LOOKING

Background:

The eyes are our most frequently used sense organs. Children can make many more discoveries by being trained to look carefully. In the following series of investigations the children are given an opportunity to become involved with shapes -- the shapes of nuts: hazelnuts, almonds, peanuts.

The hazelnuts which are used as food are imported although there are also native ones. The nut, a simple dry fruit is high in oil.

Almonds are fruits which grow in warm climates. Almonds yield much oil too.

Peanuts are fruits in the form of a pod. What we call a nut is technically not a nut. The peanut plant has a very interesting growth pattern. After the plant has flowered the stalks elongate, touch the ground and the pods develop beneath the soil. In order to collect peanuts they have to be dug out. Peanuts are very high in oil and extremely nutritious.

Several almonds and hazelnuts are included for the children to observe. The bag of peanuts is for class distribution.

Investigation:

1. How are the shapes of the three nuts different from each other?

2. Which nut is most like a circle? What objects in the room are like a circle?

3. What do you see outdoors which is like a circle?

Look in the sky, on the buildings, among plants, on the ground.

4. Are there any seeds of any size that have a shape similar to that of the hazelnut, almond, or peanut? Make a picture of each then explore the plants around the school, searching for seeds. When you find some, compare them to your drawings. Fall and winter are the best times for this investigation.

Another way to do this is to collect a little bag of assorted seeds outdoors, then place them in three piles, according to which of your nuts each resembles best.

5. In what shapes do the pods of peanuts grow? Compare yours with the others in the class.

6. How does the shape of the peanut compare to the shape of its pod? Open the pod and find the peanuts. You can then examine them.

7. How will peanuts grow best -- if you plant the entire pod or if you plant the peanut without the pod? Since these peanuts are not wasted you can try this experiment. Half the class might place their entire pods in a pot of soil and half plant the shelled peanuts. Label each according to whose it is, what it is, and place in a warm place. Water them regularly. Observe them daily.

8. Does heat change the shape of things? Try heat on butter, sugar, peanuts. What is the shape of a cup of sugar placed on a piece of paper? After it is poured into a cup? What is the shape of the butter after it is cut? What is the shape of the dish? Rub the butter over the dish. What happened to its shape?

Remove enough roasted peanuts from their pods to cover the buttered dish.

Place the sugar in a pan and heat until it melts. Pour over the peanuts. Allow to cool and harden. You now have peanut brittle candy. What is the shape of the candy? Break it up into pieces. What is the shape of your piece?

9. Other plants, besides the peanut, have seeds in pods. Locust is one kind. Examine the other plants in the area to find out whether any of them have seed pods. Do these pods appear to be used by any animals as food?

10. Perhaps there is a hickory tree or some other nut trees nearby. You might go on a "nutty" walk, looking for nut trees. What is the shape of each kind of nut that you find?

CLASSIFYING PINE NEEDLES

Background:

There are many kinds of pine trees. All have leaves in the shape of needles and are grouped as evergreens. All pine trees bear their seeds in cones. The suggested investigations of three kinds of pine trees provide opportunities for the children to learn something about these trees and something about how to classify things. Classifying items is an important process in science.

White pine needles are about 4 inches long and grow in bundles of 5. White pine trees are important lumber trees, native to this area.

Scotch pine is a favored Christmas tree by many because the needles remain on the tree long after it is cut. Although it is not native here, it grows easily and is frequently cultivated. Scotch pine needles are short about two inches long and grow in bundles of two.

The red pine is native in spite of its name. It has needles in bundles of two as does the Scotch pine but red pine needles are much longer, 4 to 7 inches long.

The three kinds of needles are arranged in the form of a "key" on a card. The bag of pine needles contains 90 assorted needles of the same three trees.

Investigations:

1. How many pine trees have you around your school? How many trees drop their leaves in the fall? Plan a walk around

the school in order to count these two kinds of trees. Take a pencil and a card with you. Make two columns. In one column make a check each time you see a pine tree. In the other column make a check for every tree you see which is not a pine tree. How many of each kind did you find?

2. Pick three bundles of pine needles from the bag of pine needles. Match one with the other. How many different kinds do you have? Match yours with those of the rest of the class. How many different kinds are there altogether?

3. Only one kind of pine tree bundle comes in bunches of five needles. Look at the "key" card. This card shows you a scheme for matching the needles. Five needles means it belongs to a white pine tree.

4. Where around your school is there a white pine? If you find one examine about 10 bundles of needles and count the number in each bundle. How many do you find each time?

5. Once you have learned something about the number of needles in the white pine tree bundles you can find out some other things about white pines. Who planted them? Why? Are they taller or shorter than other trees? What animals visit them? How do they sound when the wind blows through them?

6. How can you tell a Scotch pine from a red pine? Once you have learned that, go on another discovery walk to see how many of these trees you have. Which has the redder bark?

7. What animals visit pine trees? What are they doing? If you see any cones on the ground examine these for clues.

8. If it is Christmas time you might visit an Xmas tree

lot or store and find out whether the pine trees which you are learning about are used for Xmas trees. What Xmas trees are in some of your friend's homes?

9. How can woodsmen make sure that all the Xmas trees will not be gone? If there is any woods near your school you might take a trip to find out whether there are any new baby pine trees.

DISTINGUISHING AMONG SHAPES OF LEAVES

Background:

Instead of seeing leaves just as generalized green forms, the following experiences which invites concentration on three very different shapes common to leaves, is helpful in sharpening observation.

Maple leaves, dogwood leaves, and pine tree leaves are all green leaves but of very different shapes. All manufacture food for the trees.

The maple and dogwood leaves fall off the trees in the autumn. The pine needles persist. Evergreen needles have less surface for loss of heat and water, less surface to accumulate snow. Winds pass through the needles. These are some of the reasons why needles in the winter are not detrimental to the tree.

Evergreen trees do not have the same leaves indefinitely. The needles are shed but not all at the same time. Each needle persists for several years. This irregular shedding gives the tree its evergreen appearance.

A demonstration of three kinds of leaves is provided: maple, dogwood (The round-leaved dogwood) and pine.

Investigations:

1. How are the three kinds of leaves the same? How are they different?

2. How many trees do you find near your school with each kind of leaf? Make a picture of each kind on a separate card. Make a check on the card whose picture matches each tree you find. If

It is winter time, which kind do you find most? What do you find at other times of the year?

3. What shapes are the leaves on the ground around the school? Collect any 9 leaves. Assort them so that each of one kind are in the same pile. Now match the kinds you collected with the samples on the card. What different shapes did you find?

4. Are there more different sizes of leaves or more different shapes of leaves? You can find fallen leaves at any time of the year. Collect as many different sizes as you can. Match them. If any are the same size, throw all away except one. Count how many different sizes you have.

Now go out and collect as many differently shaped leaves as you can find. Count these.

Compare your two collections. In which are there more leaves, in the different sizes or the different shapes?

5. How different are the shapes and sizes of leaves on one tree? You might investigate a bush instead of a tree if this is easier. Compare the sizes of the leaves on the same plant as well as their shapes.

6. Examine a plant in your classroom. Compare the sizes and shapes of the leaves to find out whether they are all exactly the same or whether there are differences.

7. Do pine trees ever lose their needles? Explore the ground under a pine tree. Pick up soil and leaves. Do you find pine needles? What color are they? How did they get there? Are they all whole or are they broken? What happens to fallen

pine needles?

8. Where do snowflakes collect on a pine tree? After a heavy snowfall examine some of the pine trees. Where did the snow collect?

9. Which trees look most attractive in the winter? Take a walk around the school. What are the shapes of some of the trees? the colors? Why might you want to include some evergreen trees around the school or your home?

OBSERVING WEEDS IN WINTER

Background:

Three large plants which flower in the summer produce seeds and fruits which persist all winter. Their height and color makes them visible above the snow. All contribute to the food needs of wild animals. The seeds are sought by mice and birds. The stems may harbor dormant forms of insects and spiders.

The fruit of wild carrot forms a "Bird's nest" when it is in fruit and is frequently called bird's nest weed. In the summer its attractive head of white flowers frequently displaying a central one of garnet is usually known as Queen Anne's Lace. The root of this plant is thought to be the forerunner of the cultivated carrot.

The plant's seeds are very light and easily carried by the wind.

Dock is an indicator of poor soil. Its seeds are extremely nourishing and provide good food for wildlife. Dock is often used in dry flower arrangements.

Purple loosestrife is an exceedingly attractive plant when it is in flower on the borders of ponds and streams. It is spectacular along many banks of the Hudson River.

A specimen of each of the three weeds is enclosed in a separate bag.

Investigations:

1. Which of the three seeds might provide the most nourishment for wildlife? Shake each bag until some seeds fall off the plant. If you put one of each kind on a piece of Scotch tape you can

examine them with a magnifying glass to see which is the largest and which is the smallest.

2. Can you find anything on the seeds which look as if they can be carried by the wind? Take a few seeds outdoors on a windy day and scatter them as the wind is blowing. Which seeds are carried farthest?

3. Where around your school can you find wild carrot dock and purple loosestrife? Make a discovery hike one day and search for one of the plants. Count how many you find. Make more hikes to search for the other plants.

4. If you have snow, find out which plants are highest above the snow. How many are taller than you are?

5. Can you find any of the seeds on the snow or on the ground? Where do you find them? How was the wind stopped from blowing them farther away?

6. If there is snow go on a tracking trip. What footprints do you find near the weeds? Can you guess why? Besides footprints do you find any other evidence of visitors? What kind of footprints do you leave? Why did you visit the weeds?

7. Suppose you should wish to attract such visitors closer to the school, what might you do? Make plans to test your scheme.

8. How does the root of bird's nest weed or wild carrot smell? Pull the plant up by its roots, break the root and smell it. Compare its odor with that of a carrot which you use as food.

9. How do the plants of wild carrot compare with those of the cultivated carrot? Collect some of the seeds of wild carrot and plant them in several pots which you place on the window-sill and

water regularly. Do the same with seeds which you use to grow carrots in the garden. Keep a record of when each one is visible above the soil, when the first leaves appear, how tall each grows in a week, and anything else which you observe.

MUD

Background:

When you scoop some material from the bottom of a pond it is apt to be mud mixed with what remains from the decay of dead plants and animals. It is soft and sticky when wet.

Some muds are different, such as marl. Marl contains some form of lime. The lime in the specimen provided here comes from the shells of freshwater animals. Because of its high lime content marl is frequently dredged and deposited on farmland where it is used as a natural fertilizer.

A bag of ordinary mud is provided as well as a bag of marl.

Investigations:

1. How are the two samples of mud different from each other? How are they alike? Some of the things which you might compare are: color when dry, color when wet, how the particles feel to the touch when wet and when dry, size of particles, weight of a given volume such as 1/4 of a cup carefully measured, whether iron particles are present as indicated when a magnet is pulled through the grains, whether any other particles are present.

2. What kind of shells are found in marl? A magnifier will help to see the different kinds. Place each variety in a separate pile.

3. What appears to be the dominant shell in this sample? Count the type of shell which is present in largest quantity.

4. How do the two kinds of mud react to the lime test?

Put a little warm white vinegar into two jars each of which has a small quantity of one of the muds. Use the same amount of mud, same size container, same amount of vinegar. The vinegar used for the two samples should be of the same temperature. Which one shows active bubbling? What is the source of the lime?

5. Suppose you wished to make an indoor aquarium with a mud bottom. In which sample does the water settle clearest? Which settles first?

6. Which sample makes a better mud pie?

7. What kinds of bottoms do the ponds and puddles in your area have? Tie a strainer to an old broom handle and scoop up samples from as many places as you can find. Put each sample in a separate container. Label the container with the date, your name, and place where it was obtained. Allow the muds to dry. Then examine and test your samples so that you can compare them to the two original ones.

8. Does marl make a good fertilizer? Obtain some soil. Divide equally between four or six pots. Mix marl into the soil of half the number of pots. No marl is mixed into the soil of the remaining ones. Plant an equal number of bean, pea or radish seeds in each. Label each pot so that you know which ones have marl. Place in a warm place on a window sill. Water regularly. Observe frequently. Keep a record of when the plants are visible, how fast they grow, how sturdy they appear, etc.

9. What effect does lime have on water? You can take some water from the marl aquarium (see No. 5, above) or from a pond which has marl. To find out whether it is hard or soft

water, put some in a bottle. Put an equal amount of rain water or water from melted snow in a similar bottle. Add exactly the same amount (5 or 6) of pure soap flakes to each. Cover. Shake both bottles 10 times at the same time. Which shows more and longer lasting suds? This is soft water. How is hard water different? Make the same test with detergent to find out why soap was used in this test instead of detergent.

GRASSHOPPERS

Background:

There are more kinds of insects in the world than all other kinds of living things. There are many different kinds of insects. Lobsters, crabs and spiders are insect relatives and all of these animals have skeletons on the outside and soft body parts on the inside as well as jointed legs.

Insects have certain traits in common in addition to these characteristics just mentioned. Insects have a three-parted body. Eyes, mouth parts and "feelers" are on the front part. The middle section has three pairs of legs and wings in those insects which are winged. Breathing and reproductive parts are present on the last or abdominal section.

The grasshopper is an insect. A specimen is provided for observation and to initiate investigations.

Investigations:

1. Where are grasshoppers found? Late summer is the best time to look for grasshoppers. Immature forms which resemble the adults but are less active are found earlier. Investigate open fields, hedges, trees, water areas. Where do you find them? How do you know they are present?

2. How easy is it to spot grasshoppers? To find out what color grasshoppers are, examine the specimen in the jar. This is one common type. There are others. Select two pieces of construction paper, one the color of the specimen, another that is bright red. Cut the sheets into small pieces of paper about

the size of the grasshopper. Make the same number from each sheet. Mix both colors. Throw them into the air and scatter them. How many can you collect in two minutes? Can you explain why you have more of one color than another?

3. On what do grasshoppers feed? What clue do you get from examining their mouth parts? Examine these insects outdoors. What can you observe about their food habits?

4. With what do grasshoppers fly? Observe the straight pair of wings over the grasshopper's back. Then go out to observe the insects in flight. What color are the flight wings? Where are these wings when the insect is not in flight?

SEED PACKAGES

Background:

Next Year's plant starts with this year's fruits. The fruit contains the seeds of the plant. Seeds develop within the plant's ovary. A fruit is a ripened ovary, together with any other part of the plant which remains attached to it.

There is a great variety in shape and structure among the fruits of plants. Each type of "seed container" has unique way of scattering its seeds.

Honey locust grows into a tall tree and can grow almost anywhere. It is becoming a favorite tree on city streets. The pods are very attractive, long, twisted and shiny dark brown.

Catalpa or Indian "bean" tree is a cultivated tree but has spread. When the pods fall, they break and the seeds scatter. The flowers of this tree are large, attractive and fragrant. It has large heart-shaped leaves. Since it grows in areas where other trees do not, it can help break the wind in exposed areas. The pods hang on all winter.

Milkweed grows very tall, up to 5 feet high. What is more significant is that just beneath the soil surface may be roots 15 feet long. The flowers are beautiful, fragrant and attract many insects, particularly the monarch butterfly. The pods open in the fall but some persist all winter.

Four different kinds of "seed packages" are provided: a honey locust pod, a catalpa tree pod, a bag of milkweed pods, and a package of zinnia seeds -- all of which will be used in the suggested investigations.

Investigations:

1. How are the three kinds of pods different? Feel each, smell each, listen to each as you shake it, observe the colors. Measure each, weigh each.

2. How easily does each open? Try them.

3. Do any of these pods grow on plants around the school? When you explore your area look up on trees as well as on shrubs as well as on the ground.

4. How many seeds are there in each of the pods?

5. How are the seeds different? How are they alike? How is each type scattered where it grows into a new plant? You will have to find the area where the plants grow for a good clue after you have examined the seeds and fruits indoors.

6. Before a seed can begin to grow it has to soften. How might each of these seeds be softened? How well can they grow without being softened? Try planting some as they are, and some after softening according to your suggestion.

7. Apples and oranges are "seed packages" too. Remove the seeds. Soak half the number in water overnight and leave half unsoaked. Plant them in pots of soil. Label. Place in warm spot on a window sill and water regularly. Observe. Which plants appear first, those from soaked seeds or those from unsoaked seeds?

8. Do animals use any of these seeds as food? After you have located some of the plants which produce these seeds, observe whether any animals visit them. Since all three pods can be

observed all during the school year, this investigation can be repeated many times.

9. If you know where there is a honey locust tree full of pods, stand quietly beneath it on a windy day. What do you hear? You might collect fallen pods and using them as rattles, the class can form a honey locust band using the pods to beat a rhythm.

10. The package of zinnia seeds consists of real zinnia seeds obtained from zinnia flowers but put into a manufactured bag. These seeds can also be planted. Instead of locust trees, catalpa trees, or milkweed plants, what would you expect? Plant them and see whether what you expect will be what you get.

LEAF MINERS

Background:

After the caterpillars hatch from eggs laid on leaves by certain insects, they bore their way into the soft tissues between the top and bottom layers of the leaves. The insect spends this part of its life eating and tunneling its twisted way through the leaf. For this reason those species of flies, bees, beetles or moths which spend this part of their lives in a leaf tunnel are called leaf miners.

When the caterpillar part of the insect's life history is completed it ceases to feed, becomes a pupa, then emerges from the leaf as an adult.

If too many leaves are not mined so that the plant is not deprived of excessive food, the plant can withstand the attack by the miners.

A leaf taken from a plant whose leaves harbored leaf miners is enclosed in a transluscent envelope. It can easily be removed for examination.

Investigations:

1. In what direction did the caterpillar travel? If you first decide what happens to the size of an organism as it feeds and grows you can figure out the direction of travel.

2. The insect might have spent quite a few weeks in the leaf. How much distance did it cover? If you place a thread along the tunnel from beginning to end you can then measure the thread.

3. Late spring and early fall are the times to look for leaf miner activity. Best results are in the fall. Why? If the time is appropriate go out to examine the plants around the school.

Some very common weeds as well as garden plants have leaf miners.

4. Collect fallen leaves at any time of the year and look for miner activity. Are the leaves where you find miners the same or different? What are the shapes of some tunnels? How do the lengths of different tunnels compare?

5. What emerges from a tunneled leaf? If you find a green leaf with a tunnel in it, hold it up to the light and try to locate the insect at the end of the tunnel. Then place the leaf in a plastic bag, fasten it, and secure it to the window. Observe it regularly so that you may see the insect which emerges.

6. Not only leaf miners use leaves as food. People use leaves too. After you have listed all the leaves which you use for food visit a food market to find some you may not have known.

7. There are many other caterpillars which feed on leaves besides leaf miners. Birds feed on caterpillars. Suppose people spray DDT or other poisons to kill the caterpillars. We know that these poisons are killing birds and are also harmful to people. What would be the best way to control the caterpillars?

There are many ways to attract birds. Which is most successful around your school - suit, seeds, fruit, nesting material, nests, water?

BARK PEELINGS

Background:

Trees grow as long as they live. They grow in width as well as in height. As the trees get older the bark stretches less and cracks in various ways. Some peel.

The sycamore bark peels and falls off in dark brown sections leaving behind irregular light patches which gives the sycamore its characteristic and attractive appearance, especially striking in the winter.

Sycamore trees are common in woodlands on country roads, and on city streets. Although the kinds differ, they all have the mottled bark and the "button ball" fruits which hang throughout much of winter.

Cinnamon trees grow in warm climates. The bark is stripped and shipped. One of the principal sources for the United States is South Vietnam. It is collected during the rainy season when it is more pliable.

A purchased piece of cinnamon bark and a piece of sycamore bark are provided for some investigations.

Investigations:

1. Do any sycamore trees grow around your school? Look for trees with irregular splotches of light bark on a dark background. See whether the pattern is found on the branches as well as the trunk. Which are lighter in color, branches or trunk?

2. How does the sycamore bark peeling feel? Is it smooth or rough, soft or brittle? Explore the ground under a sycamore tree which you located. How many pieces do you find? What happened to the pieces of last year, the year before? 25 years ago?

3. Does wetness affect the sycamore peelings? Allow a few pieces to dry indoors on a warm shelf or over a radiator. Moisten a few others and put into a plastic bag. Seal the bag. Examine both specimen the next day. What is their appearance?

4. Does the weather outdoors change the shape of fallen sycamore bark? Examine some on a dry day and on a rainy day to see if they are affected by the weather.

5. Suppose you wish to crush some sycamore bark in order to make very fine pieces, what would you do first? Would you dry it or moisten it? After you make your prediction, test your idea to see whether you are right.

6. Cinnamon bark is also tree bark but it comes from the cinnamon tree, an evergreen tree. How is it like sycamore bark? How is it different? Use your eyes, fingers and nose in order to find out.

7. Which smells stronger, cinnamon stick or ground cinnamon? Make some ground cinnamon from part of the cinnamon stick. Smell both.

8. Many trees contribute to our food supply. What food supply trees can you find around your school which are used by birds, insects, people, squirrels?

MUD DAUBERS

Background:

If you find small mounds of dried mud with holes in them on the walls of attics, barns or porches you probably have mud dauber wasp nests. Each has several cells. The female builds the nest, shaping it from moistened mud.

The female finds an insect or spider, paralyzes it, stuffs it into one of the cells, lays an egg in it, seals it, then does the same to each of the other cells.

A mud dauber wasp's nest scraped from a barn wall is enclosed in a plastic box for the investigations which follow, together with an accompanying bag of dried mud.

Investigations:

1. What do animals require in a home in which they live? How are these provided in the mud dauber wasp's home?

2. Where in your area are mud dauber nests? Explore open porches, barns, tool sheds. How many did you find?

3. What are the shapes and sizes of the mud daubers' nests which you found? How many cells are there in each?

4. When is a good time of year to collect mud dauber nests? These were collected in the winter. Why would spring and summer be a poor time to do this?

5. Using the dried mud, moisten it and try to make a mud dauber's home. How do you know how to make it? How does a female mud dauber know how to build her home?

LICHENS

Background:

Lichens can grow where other plants cannot. However, lichens help produce soil. As pioneer plants lichens create conditions which eventually make it possible for other plants to grow. Lichens consist of paired plants, a green algae providing food for the non-green fungus partner.

Lichens may grow on soil, wood or rock. Specimen of all three are represented in the collection provided.

Lichens may grow in three forms but there are also forms that are in between these three. A shrubby type which grows on soil is represented by the reindeer lichen specimen. Some forms grow absolutely flat. These may be found in the trunks of trees or on rocks and are considered to be crustose lichens. The foliose or leafy type of lichen is not completely attached so that there are free leafy edges around.

Investigations:

1. Examine the lichen specimen. A magnifier will help. Compare the substance upon which they are growing if it is present, the color, shape presence of tiny coloredspore cases, how they feel to the touch.

2. Where around your school do you find lichens? Explore tree trunks logs, soil, rocks, lichen can grow in all these places all over the world where air is unpolluted.

3. What effect does moisture have on these plants? Water the specimen and observe them. Go out after a rain to explore the appearance of lichens. How are they different where wet? Which type do you see more clearly when wet than when dry?

4. The caribou in the Arctic regions depend upon reindeer lichen for their food supply. The Lapps and Eskimos in these areas depend on the caribou for their food. As a result of nuclear explosions poisonous radio-active chemicals are collecting in the lichens, increasing in the caribou and threatening the lives of the people who eat the animals.

Find some grass outside. Perhaps you live where cows feed on grass and people feed on cows and cow products. Imagine what would happen if grass might be collecting such or other poisons. What should be done?

5. Lichens help soil form on rocks and on dead wood. Find a fallen tree or part of one. How many different kinds of lichens do you find? What is the condition of the wood right under the lichen as compared to the parts of the log not covered by lichens? What other plants are growing near the lichen? What animals are finding a home there?

JAPANESE BEETLES

Background:

Many plants and animals are immigrants which are accidentally brought into this country. These organisms thrive here because conditions such as food, water, soil, and climate are satisfactory. In addition, there are no natural enemies to keep them in check. For these reasons they multiply at a much faster rate than in their country of origin.

The Japanese beetle is one such organism. Specimen were introduced from Japan in 1916 when some plants were imported into New Jersey. The insects were hidden in the soil covering the roots of the plants. Since then Japanese beetles have spread over tremendous areas in the United States.

Eggs are laid in the soil during the summer. As soon as these hatch into white larvae (grubs) they start to feed on the roots of grasses. They go deeper down into the soil as winter progresses and spend the winter there. By springtime the grub becomes a pupa, then an adult in June or July. At this time they emerge from the ground, fly around and begin to feed very actively on leaves, fruits and flowers of wild and cultivated plants.

Some specimen (dead) of the beetle are in a small plastic bag fastened to a card which also has a leaf partly eaten by Japanese beetles. In addition, there is a picture of the grub at which stage it is found underground.

Investigations:

1. Why is the Japanese beetle considered an insect? Find its head, three pairs of legs and wings. Compare it to any other

organisms which you know to be an insect. Flies are insects and they can be found indoors in the winter. You can capture one by inverting a tumbler over it. Then you can observe it. How are the insects which you find similar to the Japanese beetle? How are they different?

2. The Japanese beetle starts as an egg, then hatches into a larvae, then a pupa and finally changes into an adult. The form in which you usually see it is the adult. Examine the adult specimen, which are provided. How would you recognize it? These are found in late spring and summer. It is recommended that they be collected and dropped into cans of kerosene. Why?

3. All the three stages in the life history of the Japanese beetle are spent underground except the adult which is found above ground. Locate several areas around the school where you may dig. Mark off such areas in one foot squares. Dig down about one foot and turn the soil over. Look for the fat grubs. How many do you find? How deep in the soil are they?

4. Do the Japanese beetle grubs remain at the same depth all year or do they move up and down? Explore several areas at different times of the year. Keep a record of how many you find, the date, the depth. A grassy area is a good place to look for grubs.

5. Examine the leaf eaten by Japanese beetles. What parts were eaten? What parts seem to have been avoided? Can you explain why? Collect some fallen leaves, green as well as brown. Find the veins. Find the parts between the veins. Which is softer? Where is most nourishment found, in the veins or in the leaf sections between the veins?

6. In late summer and early fall you might find many little

holes in the ground made by the sharp beaks of robins or starlings as they search for grubs. Some birds feed on the adult Japanese beetle as well. Suppose you wish to destroy the insects and you spray DDT or another such poison on the plants or ground. How would that affect birds? How might you reduce the number of Japanese beetles without using poisonous sprays?

BIRD FEEDERS

Background:

Many kinds of birds can be fed during the winter with suet or seeds. Suet provides food for insect caters such as woodpeckers. Seeds attract jays, sparrows, cardinals, finches, chickadees. Many birds feed on both.

Birds usually establish a feeding routine and visit the same sources of food at a regular time each day. Migrant birds frequently remain in these areas instead of flying south, if there seems to be a supply of food for them. It is, therefore, important to continue supplying food once the birds begin to come to feeders. Even one cold day without food can prove fatal to a bird.

Materials for making two wire suet feeders are provided, as well as two kinds of seeds. A booklet on suet feeders gives some hints for feeding birds.

Investigations:

1. Which of the two kinds of seeds in the package seems to attract more birds? First make two suet feeders out of the hardware cloth. Fold up 6 inches as shown. Fasten each at four places marked "X". After the suet is pushed into the "pocket" which you have formed, fold the flap over. Hang them outdoors where cats, dogs and squirrels do not get the food.

Melt down 2 equal quantities of suet in separate pans. When cool, add one kind of seed to each pan. How will you decide that you have the same amount of seed in each? Then let the suet turn cold

and firm, and fill each suet feeder with the contents from one pan. Be sure to label the kind of seed in each feeder.

Plan when to observe and keep a record of the number of birds feeding from each feeder.

2. What are bird seeds? Some may be seeds of flowers which you recognize. You might obtain some mixed bird seed and sort the seeds out so that you have piles of each kind. How many kinds are there? If you plant each kind in separate containers you can find out what grows from these seeds.

3. Can you attract more birds with other kinds of seed which you select?

4. Do birds feed on any food which people eat? Try feeding birds some of the things you eat, such as bread, doughnuts, eggs, meat, oranges and other items of food. Which are eaten?

5. If the feeders are over bare soil observe this soil in the spring. Compare what grows under the feeders with the plants which grow several feet away. If there is no soil on the ground under the feeders you can place a box of soil there.

6. Is there evidence of any four-footed visitors to the area? Look for footprints in snow or mud or sand which you have poured under the feeders. Try to find out which animals are attracted and why.

7. From observing the habits of the birds such as, what they feed upon, their feeding habits, where and how they perch, the numbers which flock at a feeder determine what advantages there are to feeding birds. What disadvantages do you find?

MOSS

Background:

Mosses are green plants lacking roots and true stems such as flowering plants have. There are many kinds: most kinds grow on soil, some grow on trees and there are also some aquatic forms. Mosses grow all over the world, in all climates and in high as well as low altitudes. Most mosses are just a few inches high.

Mosses develop from spores. Spores are produced in little capsules. When a spore germinates, it forms what we recognize as the moss plant. This is the green leafy form which eventually develops sex organs, one kind producing eggs, the other sperms. The union of an egg and sperm results in the development of a capsule with spores. The capsule is usually supported on a stalk and obtains its nourishment from the green part of the moss, out of which it grew.

The hairy cap moss, the larger of the two specimen, is a very common moss. The smaller is provided for comparison. The mosses may be freshened by soaking them in water for a few minutes and then squeezing the water out again very gently.

Investigations:

1. Are there mosses growing around your school? Examine the two specimens indoors. What colors are the various parts? Then explore the outdoor areas around your school looking on live trees, dead ones which are still standing, dead ones which have fallen and are now logs, stones, soil, buildings. Where do you find moss growing? Which ones resemble your specimen?

2. Does "moss" grow on the north side of trees? What is referred to here is not a moss plant. It is a simpler plant, one of the algae. Algae more often grow in water. There is one common kind which grows on wood. Examine trees and wooden parts of buildings around your school looking for a flat greenish growth. Using a compass, determine on which side the algae grow in each case. Can you decide from your observations, what are the most suitable growing conditions for this plant?

3. How do mosses start growing? Examine the little stalks and the swollen tips on top of the stalks. If you open one of these capsules and tap the open part gently onto some white paper you can see the green spores. You will need a magnifier to see them distinctly. These spores start new mosses when they land on a surface which is suitable for their development. How many different kinds of moss capsules can you find? Autumn is the best time to look. Try to see whether you can count the number of spores any one capsule contains. Why are mosses considered to be "soil makers?"

4. How fast do mosses grow?

It will be best to provide a place to grow them indoors. A glass or a plastic dish with a similar cover is best. Make a foundation of about one inch of the following mixture: 2 parts dry sphagnum, part ferl-loam, 1 part charcoal (all available at florist shops). Collect one or more samples of moss. Moisten them. Place them in the dish. Place some toothpicks next to 10 or 12 plants. Indicate the top of each moss plant with a mark on the toothpick next to it. Do this once a week in order to measure the rate of growth.

FOOD FOR WILDLIFE

Background:

Animals require a steady supply of food in order to live. During spring and summer this may be plentiful. As cold weather approaches animals which are not assured of a winter supply may migrate or hibernate. Feeding evidences are always available.

Two kinds of animal food are presented here. One is the nut from a hickory tree which shows the teeth marks of a gnawer, a mouse. The beaver is also a rodent. His teethmarks are shown on the second kind of animal food, wood.

Investigations:

1. What kinds of food do animals feed upon? Examine the hickory nut and wood chips. Then go out around the school and see whether you can discover any kind of wood pieces or nuts with toothmark evidences.

2. What other indirect evidences of animal feeding can you find? Some clues are: sawdust at the base of a tree, animal droppings, incomplete pine cones on the ground, bark stripped at the base of trees or low branches, lower growth of young trees and shrubs broken.

3. How can you identify the night-feeding animals? One way is to provide some of the foods you have found being used by animals. Sprinkle sand around it so that footprints remain after the animals visit. Then identify the footprint. If there is snow, you might identify the animal by his tracks, especially a day or two after a good snowfall.

Animals return to sources of good food supply. If food is provided night feeders will come regularly. Skunks, oppossums, raccoons and others are easy to "invite."

4. What animals do their feeding in the daytime? Provide nuts, seeds, suet and watch. Look for birds, red and gray squirrels and others. Sometimes rats are attracted too.

5. What animals feed on dried weeds and fruits? Here you can make direct observations outdoors. Select a morning or afternoon time when you will find some activity and observe a given area regularly.

6. Animals feed on the seeds of pine cones and the seeds and fruits of other trees as well as of a great variety of wild plants. How is it that all these plants grow in the spring and are not destroyed by the feeders? Explore the area around the school to find the kinds of plants used by wildlife. Select some cones if you have a pine tree. If the cones are unopened place on a plate over a warm radiator while they open. Count the seeds in each cone.

Collect fruits of as many different plants as you can and count the seeds.

Count the pods on a locust tree and estimate the number of seeds by counting the number of seeds in several pods.

Estimate the seeds produced by a maple tree, a catalpa, a sycamore in the same way. All these trees have fruits which persist all winter.

Find out whether there are seeds present in November, December, January, February, March and how easy they are to find.

How does the number of seeds relate to the continued survival of the plant?

7. How do the habits of wildlife help the plants upon which they feed to survive? If you have oak trees look for acorns, the fruit of the oak. If there are acorns look for squirrels. Observe what squirrels do with acorns. If there are squirrels but no acorns scatter some peanuts or hazlenuts. What the squirrel does with the food he does not eat immediately should give you a clue of how he maintains a food supply.

Look for other kinds of clues such as the seeds embedded in animal droppings.

8. What is the best place for attracting wildlife which you wish to observe? Explore the places where you have found animals feeding and the places where you found evidences of their feeding. Are the feeding areas out in the open or are they protected? What kind of protection do animals seek? How can you provide both food and cover (protection?)

CLUSTER FLIES

Background:

Cluster flies look like clumsy houseflies. They move more slowly and are slightly larger than the more familiar fly. Somehow, the clusterfly found its way to America from Europe. It probably came unnoticed in the egg, larva, or pupa stage. Once it landed in the United States, found adequate food, earthworms to serve as a parasitic source for its eggs, homes of the right types in which to winter, not enough natural enemies to destroy it, the clusterfly multiplied and multiplied and is a thriving insect. It can be a tremendous source of annoyance indoors from fall to the following spring. In early fall as they force their way into homes through seemingly invisible chinks, floors, especially attic and upper story floors are truly black with the hundreds of thousands of these insects. They are easy to collect and study. The cluster flies in the little bottle come from such an attic. Some were placed on Scotch tape so that the hairs on the body and the position of the wings could be observed.

These insects, because of their size and year round availability are suitable for study. So far it has been observed that cluster flies are attracted to the light above 50° F and to the dark below 50° F.

Investigations:

1. What characteristics of the clusterflies resemble those of other jointed-legged animals such as lobsters, crayfish, spiders? Why are these flies grouped as insects?

2. How are clusterflies different from other common flies? Houseflies are found in warm interiors. One can be captured alive by inverting a glass tumbler over it very quickly. While you are doing this note whether you are more successful if you come down vertically over the fly or if you capture it from the side.

Another fly which is easy to collect for this investigation is the fruit fly. If you place a piece of banana skin in a jar and leave it in a warm place for a few days fruit flies will be attracted to it.

With the three kinds of flies you can compare them as to size color, shape, eyes, position of wings at rest, method of grooming, presence or absence of body hairs. Whatever investigations are carried on with clusterflies can be duplicated with the other kinds of flies.

3. If you discover a source of clusterflies find out where in the room most of them are located. Try to figure out what attracts them.

4. Are there more flies in the sunshine or in the shade? Observe walls and windows indoors. Explore walls and windows outdoors. Do white and light surfaces have a greater or lesser number of flies than surfaces of other colors? With the help of your compass decide which direction is the preferred location of the majority of the flies, north, east, south, west.

5. Is light or warmth the greater attraction? Spring, fall and winter are excellent times for this investigation. First find out where there are more flies, indoors or outdoors. Compare the temperature readings of both location.

6. How active do clusterflies become when attracted by light

in a very cold environment? Place some ice cubes in a wide-mouthed ice jug and close it until it becomes very cold. Take a temperature reading above the ice. It should read below 50° F before you proceed. Place the jug where there are many clusterflies. Leave the lid off. Observe after an hour.

7. Where are there active clusterflies outdoors in cold weather. Investigate walls and walks on several cold days. Keep a record of the different temperatures. Be sure to explore the surface of snow. Look carefully. Clusterflies are not the only insects you may encounter on top of snow.

8. How do clusterflies react to a chilled air atmosphere which also has a bright light? Again, chill the inside of an ice bucket with ice cubes and place a lighted flashlight among the cubes in order to observe whether clusterflies are attracted.

9. How can one solve the problem of getting rid of clusterflies? It is recommended that since they are parasitic on earthworms that the ground surrounding the house be saturated with poisons to kill the earthworms. What effects on other living things besides houseflies can you see as a result of this practice?

SANDS

Background:

Sand is made of grains of minerals which are courser than dust but finer than gravel. Rocks break down to form sand mechanically or chemically. The mechanical changes take place when the rocks break into smaller and smaller fragments. Rocks split when fire causes them to expand. They split as the result of pressure caused by the growth of plant roots. When water gets into cracks of rocks and freezes the rocks also crack because frozen water expands. Chemical breakdown of rocks is brought about by changes of the various chemicals which make up the rock. These changes actually cause the rocks to decay.

Dune sands are blown about by wind and are small, angular and duller than beach sands due to rubbing.

Glacial sand is not very polished and is therefore more angular than beach sand. It is not very uniform and has more clay than beach sand.

Beach sand is more uniform because it is sorted by waves. There is much quartz in beach sand.

Oolitic sands come from Great Salt Lake. They are included for comparison. Deposits of minerals from the lake formed around a speck of dust, a brine shrimp egg or a fecal pellet (dropping) of a brine shrimp to form the oolitic sands or ooliths.

Samples of oolitic sand, beach sand, dune sand, and glacial sand are provided.

Investigations:

1. How are the 4 kinds of sands different? How are they alike? Examine a few grains of each with the best kind of magnifier you can get. Look for comparisons in size, color, edge brilliance.

2. What kinds of sands are in your neighborhood? Sand is found in many areas: in a sand pit, a sand box, a swimming hole, on the roadside. Collect samples. Label each as to origin. Examine and compare to original 4 samples.

3. Do any of the sands include iron particles? Move a magnet through each of the sands. Which has the most iron?

4. Do any of the sands have lime? Many sands are known as limesands. They contain calcium from the bodies of lime-bearing plants. In fact, parts of these organisms can be seen very clearly under a good magnifier. Add some warmed vinegar to a sample of each type of sand that you are investigating. Which produce bubbles, an indication of lime?

5. How big are the sand grains?

If possible, get a millimeter ruler. If not, draw a line one inch long. Divide it into 5 equal parts and then divide each again 5 times. Each of the spaces is one millimeter. An inch is equal to 25 mm (the abbreviation for millimeter). Measure several sand grains of each type of sand. What is the biggest? What is the smallest?

6. How do the articles of clay, sand, gravel compare in size? Use your mm ruler. Which is smaller than sand? Which is larger?

7. What size particles are around the edge of a dried water puddle? in the center? Compare several outdoor water puddles which have dried. Can you explain why the various-sized grains are found where they are?

8. What happens to sand when it is mixed with water? How does it compare to clay mixed with water? Mix 1 teaspoon sand into a jar of water. Stir. Allow to stand. Do the same with some dry clay or silt. Use chalk dust instead if no clay or silt is available. Compare the two immediately after mixing, 1/2 hour later, two hours later, the next day. Where are the particles of sand? of clay?

MAPLE LEAVES and FRUITS

Background:

Maple trees of various kinds are quite common. Each has its unique shape, leaf, fruit, bark and each fits into its living community somewhat differently. In order to distinguish one from another it is interesting to become familiar with points of differences.

Students will be given an opportunity to learn what a "key" is to finding the identity of each of several maples through the use of this device.

Each maple has similar but somewhat different fruits. The fruits of Norway sugar, striped and silver maples are arranged on a card to form a Maple Fruit Key. A bag of "unknown" maple fruits are provided to learn how to use the key.

A collection of different kinds of maple leaves is enclosed for practice in developing a Maple Leaf Key. The leaves are from silver, sugar, red and striped Maples.

Investigations:

1. How many different kinds of maple fruits do you have? Take several and compare them. Then compare them with those of the rest of the class.

2. What kinds of maple fruits do you have? Examine the Maple Fruit Key. Make a choice between 1a and 1b. If the wingtips are pointing opposite, it is Norway Maple. If it is not go on to number 2. Make a choice. Continue in this way to select the description which is the most accurate until you identify the tree from which the fruits came.

3. What kind of maple trees might you have around the school? Some maple fruits are found in the spring, some in the fall. You can find some on the ground almost always. Collect a handful and "key them out". Use your Maple Fruit Key. If you have some that do not fit you are ready to go to a more advanced key.

4. How do the maples around your school compare with each other? Examine the trees for general overall shape, height, leaves, buds, fruit.

5. Where in the maple fruit do you find the seeds? Remove such a seed. What part of the fruit do you think animals eat? Collect as many different kinds of maple fruits as you can. Remove the seeds. Try to make a Maple Seed Key.

6. How do maple leaves differ from each other? Classify the four kinds of maple leaves provided according to any points of likenesses and differences that you can determine. Make a Maple Leaf Key, using these 4 leaves.

7. How many more different maple leaves grow outdoors? Collect as many different maple leaves as you can. You can find them under the snow in the winter. You can make a more elaborate key with your additional leaves. You can use one of several texts to get the exact names of the maple trees whose leaves you have.

8. How do the young leaves of maple trees compare with the leaves of more mature trees? You can find some young trees. You can plant some young trees. Examine the size of leaves as well as all the other characteristics which you have observed.

SPHAGNUM

Background:

Sphagnum is a moss which grows in temperate climates and is known as a peat moss. It is found in bogs and shallow ponds. Sphagnum lacks true roots and stems as do all mosses. It has leaves without veins which is different from the veined leaves of higher plants.

Sphagnum has 2 kinds of cells in its leaves: green ones which make food and large dead ones which store water. The stalked capsule which contains the spores is not frequently found.

A bag of dried sphagnum and a bag of dehydrated potatoes is enclosed.

Investigations:

1. How much water can the sphagnum absorb? Weigh the sphagnum. Start with a small measured amount of water which is poured into the plastic bag. Wait until all the water is absorbed. Continue to add water slowly until no more water is absorbed. Now weigh the moistened sphagnum.

2. What uses are made of the fact that sphagnum holds much water? Some eskimos use sphagnum as diapers. Nurserymen use moist sphagnum for shipping cut flowers. Can you think of others?

3. How is the growth of plants affected by soil mixed with sphagnum. Plant several cuttings of the same kind of plant in a number of pots containing the same kind of soil. Set up an identical number of the same kinds and sizes of cuttings in similar pots with the same kind of soil to which sphagnum has been added.

Place these in a warm place and water regularly. Which grow best? Which is the experiment? Which is the control? Why is a control necessary?

4. Can sphagnum improve clay soils? Repeat the same kind of experiment as in #3, above, using clay soils. Try seeds instead of cuttings to see whether there is a difference.

5. Can clay soils hold more water if sphagnum is added? Place equal amounts of clay soil and sphagnum to fill one plastic pot leaving about a 3/4 inch space on top. Set over a glass jar. Do the same thing with another plastic pot and jar but use only clay soil without sphagnum. Pour 1 cup of water in each pot. Allow to drip through. Which pot retained most water?

6. Where can you find sphagnum growing? Examine the mosses on the ground under trees, in the open, along streams, ponds, bogs. Where do you find sphagnum? If you find some, squeeze it hard. How much water do you get from a handful of sphagnum?

7. Why are so many foods dehydrated today? Do they last longer? Put one cup of the shredded potatoes aside and put some of the remainder in a small dish. Place on a shelf. Next to it put a slice of raw potato. Examine regularly. Which spoils first?

8. How much water can a given amount of dehydrated potato absorb? Do the same thing with the potato that you did with the sphagnum in #1. Which takes up more water, potato or sphagnum?

9. Which is faster to prepare, fresh potatoes or dehydrated potatoes? With the cup of potato flakes make the mashed potatoes according to directions.

keeping track of the time. Prepare about 3 fresh potatoes. Season as in the dehydrated. Keep a record of time. Which finished first?

10. Which tastes best?